U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB80-110182

Estech General Chemicals Corporation, Duette Mine Manatee County, Florida. Resource Document Meteorological Conditions

Conservation Consultants, Inc, Palmetto, FL

Prepared for

Environmental Protection Agency, Atlanta, GA

Oct 79

PB80-110182

United States
Environmental Protection
Agency

Region 4
345 Courtland Street, NE
Atlanta, GA 30308

EPA 904/9-79-044B
October 1979

EPA

Environmental Impact Statement

DRAFT

Estech General Chemicals Corporation
Duette Mine
Manatee County, Florida

METEOROLOGICAL CONDITIONS

RESOURCE DOCUMENT

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA 904/9-79-044B	2.	3. Recipient's Accession No. PB 80 110182
4. Title and Subtitle: Draft EIS Estech General Chemicals Corporation Duette Mine, Manatee County, Florida Volume B Meteorological Conditions Resource Document			5. Report Date: October 1979 6.
7. Author(s): EIS Preparation Section, EIS Branch, S&A Division			8. Performing Organization Rept. No.
9. Performing Organization Name and Address: Conservation Consultants Inc. P.O. Box 35 Palmetto. FL 33561			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address: EIS Branch, U.S. EPA 345 Courtland, St. Atlanta, GA 30308			13. Type of Report & Period Covered: Draft EIS 14.

15. Supplementary Notes

16. Abstracts

The Draft Environmental Impact Statement for the Estech General Chemicals (formerly Swift Agricultural Chemical) Duette Mine is enclosed for your review and comment. The document has been prepared pursuant to Section 102 (2)(C) of the National Environmental Policy Act (NEPA) Public Law 91-190) and applicable EPA regulations at 40 CFR Part 6.9. Thirteen volumes of resource document were also prepared. These resource documents comprise the detailed technical evaluations of the alternatives and the proposed action and contain supporting data related to the Draft EIS. While the Draft EIS is a complete document.

17. Key Words and Document Analysis. 17a. Descriptors

Volume B
Meteorological Conditions
Duette Mine
Phosphate
NEPA

17b. Identifiers/Open-Ended Terms

17c. COSATI Field Group

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 41
	20. Security Class (This Page) UNCLASSIFIED	22. Price A03-A01

METEOROLOGICAL CONDITIONS

RESOURCE DOCUMENT

Draft Environmental Impact Statement

Swift Agricultural Chemicals Corporation
Duette Mine Site
Manatee County, Florida

October, 1979

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30308

Prepared by:

CONSERVATION CONSULTANTS, INC.
Post Office Box 35
Palmetto, Florida 33561

METEOROLOGICAL CONDITIONS
RESOURCE DOCUMENT

TABLE OF CONTENTS

		Page
	LIST OF TABLES	ii
	LIST OF FIGURES	iii
1.	INTRODUCTION	1
2.	DATA SOURCES	2
3.	TEMPERATURE	2
4.	PRECIPITATION	5
5.	EVAPOTRANSPIRATION	14
6.	DISPERSION PHENOMENA	16
	6.1 Wind Direction and Speed	18
	6.2 Wind Distribution by Stability Class	22
	6.3 Mixing Depth and Ventilation Factors	24
	6.4 Episode Occurrence Frequency	27
7.	SEVERE WEATHER	27
	7.1 Tropical Cyclones	27
	7.2 Tornados	29
	7.3 Hailstorms	29
	7.4 Windstorms	29
	7.5 Thundershowers	30
	BIBLIOGRAPHY	31

METEOROLOGICAL CONDITIONS
RESOURCE DOCUMENT

LIST OF TABLES

		Page
Table 3-A	Average Annual Temperature (°F) Summary for Parrish and Bradenton, 1962-1977	4
Table 3-B	Temperature (°F) Summary for Parrish, Bradenton, Lakeland, and Tampa	6
Table 3-C	Normal and Average Extreme Temperatures for Tampa, Florida, 1890-1977	7
Table 4-A	Annual Precipitation (Inches) Summary for Parrish and Bradenton, 1962-1977	8
Table 4-B	Precipitation (Inches) Summary for Parrish, Bradenton, Lakeland, Tampa, and the Duette Mine Site	10
Table 4-C	Comparison of Parrish, Bradenton, Lakeland, and Tampa Precipitation Data to Site-specific Data for 1975-1977	11
Table 4-D	Summary of National Weather Service Data and Data Collected on the Proposed Mine Site Depicting Geographical Variation	12
Tampa 4-E	Average Monthly Precipitation (Inches) for Tampa Weather Station for the Period 1890-1977	15
Table 5-A	Open Pan Evaporation Rates for Lake Alfred (1971-1977)	17
Table 6.1-A	Seasonal Wind Distribution Frequency and Wind Speed for Lakeland (1942-1945)	19
Table 6.1-B	Seasonal Wind Distribution Frequency and Wind Speed for Tampa (1965-1969)	19
Table 6.1-C	Select Wind Speed Exceedance Frequency (% of Total Time) for Tampa, 1965-1969	23
Table 6.2-A	Seasonal Relative Frequency Wind Distribution by Pasquill Stability Classes for Tampa, 1965-1969	25

LIST OF TABLES
(Continued)

		Page
Table 6.3-A	Mean Annual and Seasonal Maximum and Minimum Mixing Depths (M) for Non-Precipitation Events, with Mean Wind Speeds (M/Sec) through the Mixing Depth and Ventilation Factors (M^2/Sec) for Tampa for the Period 1960-1964	26
Table 6.4-A	Frequency of Episodes for Tampa, Florida from 1960 through 1964	28

METEOROLOGICAL CONDITIONS
RESOURCE DOCUMENT

LIST OF FIGURES

		Page
Figure 2-1	Location of Weather Observation Stations in Relation to the Duette Mine Site with Observations made at Each Site	3
Figure 4-1	Normal Precipitation and Departures from Normal for the U.S. National Weather Service Stations at Bradenton, Lakeland and Tampa, 1950-1975	13
Figure 6.1-1	Seasonal Wind Roses for Lakeland, 1942-1945	20
Figure 6.1-2	Seasonal Wind Roses for Tampa, 1964-1969	21

NOTE:

Effective August 1, 1979, Swift Agricultural Chemicals Corporation changed its name to Estech General Chemicals Corporation.

The preparation of the Draft Environmental Impact Statement was substantially completed at the time of the name change. Therefore, the name of Swift Agricultural Chemicals Corporation (Swift) is used throughout the Draft Environmental Impact Statement and all attendant Resource Documents.

METEOROLOGICAL CONDITIONS

1. INTRODUCTION

The proposed Swift Duette mine site is located in west central Florida, which experiences typical semitropical climatic patterns. The area's latitude, proximity to the Atlantic Ocean and Gulf of Mexico, and its numerous inland lakes are all factors which strongly influence the regional climatic conditions.

An analysis of the data obtained from surrounding weather stations suggest that this area sustains only two general seasons (winter and summer) in regard to temperature and precipitation. Summers are long, warm, and relatively humid. Extremely high temperatures are rare in this area due to the land-sea breezes along the coasts and the afternoon thunderstorms throughout the state. The warmest months are July and August. Winters are generally mild with periodic invasions of cool to cold air from the north. The coolest months are December and January. The annual mean temperature varies from the upper 60's in the northern portion of the state to nearly 78°F in Key West.

Rainfall is variable both geographically and temporally, ranging from 50 to 60 inches per year. The seasonal distribution is uneven with over 50 percent of the precipitation occurring during the summer rainy season (June through September).

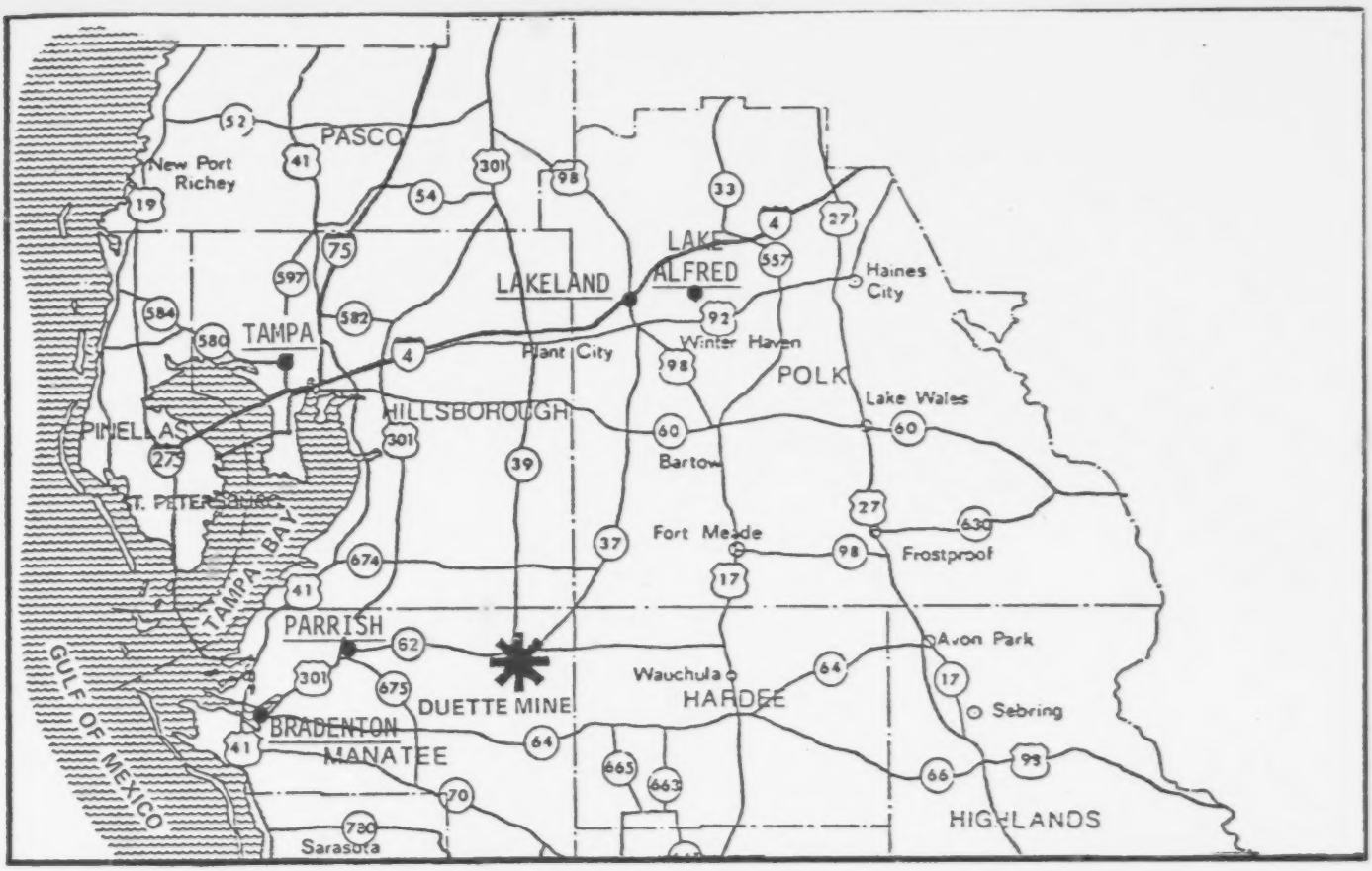
2. DATA SOURCES

Local and regional observations were used to supplement on-site measurements which are limited to two years of precipitation data. The weather records from Parrish, Bradenton, Lakeland, and Tampa are used to construct a suitable baseline description of the proposed mine site and satisfy the more sophisticated requirements for atmospheric dispersion modeling.

The records for Parrish and Bradenton include temperature and precipitation, however, they are incomplete in some cases. Lakeland has more complete records and includes a long-term wind data summary, however, the most recent summary of these data is for the period 1942 through 1945. The most complete and sophisticated data are those collected for Tampa and include temperature, precipitation and recent wind data summaries. An additional asset of Tampa weather station is that it was a data collection point for the mixing depth study done by Holzworth (1972) thus providing more elaborate data. Figure 2-1, shows the location of these weather stations in relation to the proposed mine site and provides a listing of the observations made.

3. TEMPERATURE

Temperature data for the locations discussed in Section 2, were examined. A fifteen year record summary taken from "Climatological Data" (N.O.A.A., 1962-1977) indicates that the data for Parrish and Bradenton would be of limited use due to incompleteness as shown in Table 3-A. The annual means are used, however, as an indication of



Weather Station	Years of Record	Measurements
Duette Mine Site 1	3	Precipitation
Duette Mine Site 2	3	Precipitation
Parrish	15	Precipitation (Estimated Record) Temperature (Incomplete Record)
Bradenton	15	Precipitation (Estimated Record) Temperature (Incomplete Record)
Lakeland	62	Precipitation Temperature Wind Distribution
Lake Alfred	7	OPEN-PAN Evaporation (Incomplete Record)
Tampa	87	Precipitation Temperature Wind Wind/Stability Mixing Heights

FIGURE 2-1 LOCATION OF WEATHER OBSERVATION STATIONS IN RELATION TO THE DUETTE MINE SITE WITH OBSERVATIONS MADE AT EACH STATION

TABLE 3-A

AVERAGE ANNUAL TEMPERATURE (°F) SUMMARY FOR PARRISH & BRADENTON
(Source: NOAA, National Climatic Center, Environmental Data Service)

YEAR	PARRISH	BRADENTON
1977	Incomplete Yearly Record	70.4 M
1976	Incomplete Yearly Record	70.4 M
1975	Incomplete Yearly Record	72.9 M
1974	73.9 M	72.6 M
1973	73.0	72.2
1972	73.6	72.5
1971	73.1	72.2
1970	71.8 M	72.4 M
1969	72.4 M	Incomplete Yearly Record
1968	71.9	Incomplete Yearly Record
1967		
1966		
1965		
1964	73.5	71.9
1963	72.3	71.2
1962	Incomplete Yearly Record	71.6
Mean	72.8	72.0

M = 1 to 10 days record missing.

the approximate annual mean temperatures. The temperature records for Lakeland and Tampa are extensive and complete. The data for these four weather observation stations are summarized and compared in Table 3-B.

It is readily apparent from these data that there is very little variation in annual normal temperatures for the local area. This being the case, the Tampa temperature data should provide a description of the expected temperatures for the proposed mine site. These data are discussed in more detail below.

Table 3-C, presents monthly temperature normals and extremes for the Tampa weather station. The data are taken from "Local Climatological Data, Annual Summary with Comparative Data, 1977, Tampa, Florida" (N.O.A.A., Environmental Data Service, National Climatic Center). The average monthly temperature varies from 61.0°F in January to 82.0°F in August. The winter of 1976-77 was the coldest on record with January, 1977 being the coldest January on record. The minimum average yearly temperature on record since 1938 is 70.5°F in 1969. The maximum average yearly temperature is 74.3°F in 1948.

4. PRECIPITATION

Precipitation data were examined for the site and the four weather observation stations discussed in Section 2. Again the records for Parrish and Bradenton (summarized in Table 4-A) were found to be incomplete with several years recording only estimates of total precipitation. It should be pointed out that Peek (1958) reports more extensive data for Bradenton, however, the source of these data could not be located through the U.S. Weather Bureau. The two are,

TABLE 3-B

TEMPERATURE (°F) SUMMARY FOR PARRISH, BRADENTON, LAKELAND, AND TAMPA
(Source: NOAA National Climatic Center, Environmental Data Service)

City	Years of Record[1]	Annual Normal Temperature(°F)	Extremes	
			Minimum	Maximum
Parrish	9	72.8	---	---
Bradenton	11	72.0	61.0	82.0
Lakeland	62	72.5	62.9	82.0
Tampa	87	72.2	63.3	81.1

[1] Number of years used to compute annual means.

TABLE 3-C

NORMAL AND AVERAGE EXTREME TEMPERATURES (°F) FOR TAMPA, FLORIDA, 1890-1977, (NOAA National Climatic Center, Environmental Data Service, 1977)

Month	Normal	Average Minimum	Average Maximum
January	61.0	51.6	70.3
February	62.2	52.8	71.6
March	66.8	57.3	76.2
April	71.5	61.8	81.1
May	76.9	67.5	86.3
June	80.7	72.2	89.1
July	81.8	73.9	87.6
August	82.0	74.0	89.9
September	80.6	72.6	88.5
October	74.6	66.0	83.2
November	67.0	57.6	76.3
December	61.9	52.5	71.3
Annual	72.2	63.3	81.1

TABLE 4-A

ANNUAL PRECIPITATION (INCHES) SUMMARY FOR PARRISH AND BRADENTON (1962 - 1977)

Year	Parrish	Bradenton
1977	43.90 E	44.41 E
1976	41.24 E	51.15
1975	46.53 E	46.92
1974	44.29	49.28
1973	51.98	54.77
1972	46.72	41.03
1971	50.60	49.61
1970	44.79	49.02
1969	70.50	73.11 E
1968	61.77	59.79 E
1967		
1966		
1965		
1964	50.00	44.30
1963	61.03	60.78
1962	55.87 E	59.98
Mean	51.48 E	52.61 E

E - Amount is wholly or partially estimated.

therefore, of limited analytical use. The mean annual precipitation values are presented only as an approximation. Site specific data were collected for the three year period from 1975-1977, and are included for comparative purposes. A summary of these data is presented in Table 4-B.

Table 4-C, presents a precipitation data comparison for the regional weather observation stations and proposed mine site for the period of simultaneous measurement, 1975-1977. The maximum geographical variation in the regional data was 5.42 inches in 1975, 9.91 inches in 1976, and 13.51 inches in 1977. Rain gauges located within a few miles of one another at the proposed mine site recorded variations of 8.50 inches in 1975, 9.20 inches in 1976, and 5.00 inches in 1977. These precipitation variations are summarized in Table 4-D. This data demonstrate that the variations in precipitation measured at distant locations within the region may also occur at distances of a few miles.

The temporal variation can also be expected to be quite high. This is illustrated in Figure 4-1, which presents departures from the normal precipitation for Bradenton, Lakeland, and Tampa for the period 1950-1975.

A comparison of the Tampa data with site-specific data suggests the Tampa data is within the expected range of variation and may be considered to provide a reasonable long-term description of the baseline condition for the proposed Duette Mine Site.

The average annual precipitation for Tampa is 48.71 inches of which over fifty percent occurs during the well defined rainy season (June

TABLE 4-B

PRECIPITATION (INCHES) SUMMARY FOR PARRISH, BRADENTON, LAKELAND, TAMPA AND THE DUETTE MINE SITE

Site	Years of Record	Mean Annual Precipitation	Minimum Precipitation (year)	Maximum Precipitation (year)
Parrish	13	51.48	41.24 E (1976)	70.50 (1969)
Bradenton[1]	65	54.6	29.45 (1944)	75.78 (1900)
Lakeland	62	50.10	35.83 (1961)	70.24 (1959)
Tampa	87	48.71	28.89 (1956)	70.43 (1957)
Duette Mine Site Rain Gauge No. 1	3	48.31 E	42.56 E (1975)	59.78 (1977)
Duette Mine Site Rain Gauge No. 2	3	46.08 E	38.40 (1976)	50.06 E (1975)

[1] From Peek, 1958, Florida Geological Survey.

E Amount wholly or partial estimated (Ref. Table 2-4).

TABLE 4-C

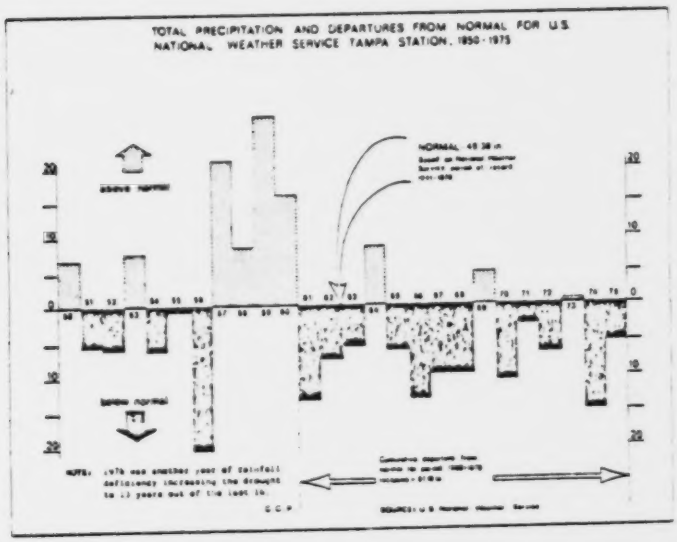
COMPARISON OF PARRISH, BRADENTON, LAKELAND, AND TAMPA
PRECIPITATION DATA TO SITE-SPECIFIC DATA FOR 1975-1977

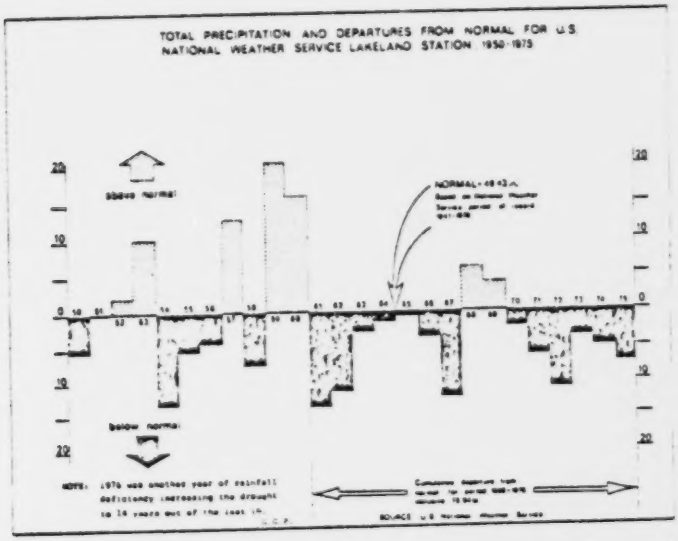
Observation Station	Precipitation (inches)		
	1975	1976	1977
Parrish	46.53 (estimated)	41.24 (estimated)	43.90 (estimated)
Bradenton	46.92	51.15	44.41 (estimated)
Lakeland	41.50	49.94	31.67
Tampa	43.44	42.29	45.18
Duette Mine Rain Gauge No. 1	42.56 (estimated)	47.60	59.78
Duette Mine Rain Gauge No. 2	50.06 (estimated)	38.40	49.78

TABLE 4-D

SUMMARY OF NATIONAL WEATHER SERVICE DATA AND DATA COLLECTED ON THE PROPOSED MINE SITE DEPICTING GEOGRAPHICAL VARIATION

Year	Maximum Variation (Inches)	
	National Weather Service	Duette Mine
1975	5.42	8.50
1976	9.91	9.20
1977	13.51	5.00


TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL FOR U.S.
NATIONAL WEATHER SERVICE TAMPA STATION, 1950-1975
above normal
below normal
NOTE: 1976 was another year of rainfall deficiency increasing the drought to 13 years out of the last 16.
G.C.P.


TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL FOR U.S.
NATIONAL WEATHER SERVICE LAKELAND STATION 1950-1975
above normal
below normal
NOTE: 1976 was another year of rainfall deficiency increasing the drought to 14 years out of the last 16.
G.C.P.

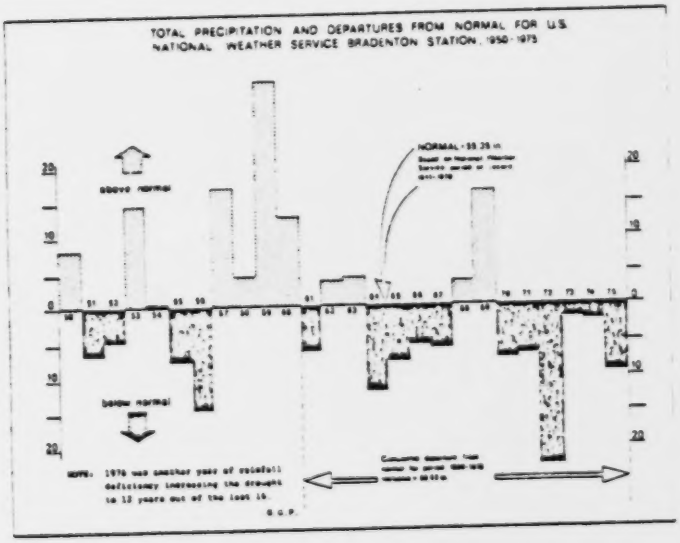

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL FOR U.S.
NATIONAL WEATHER SERVICE BRADENTON STATION, 1950-1975
above normal
below normal
NOTE: 1976 was another year of rainfall deficiency increasing the drought to 13 years out of the last 16.
G.C.P.

FIGURE 4-1 TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL AT SELECT NATIONAL WEATHER SERVICE STATIONS, 1950-1975

through September). During the rainy season, thundershowers can be expected during the late afternoon and early evening hours. Precipitation during the remaining eight months is mainly due to the passage of frontal systems through the area. The wettest month is August and the driest is November. The average monthly precipitation values for Tampa are presented in Table 4-E. The period of record for the averages is from 1890-1977, and the minimum-maximum data are for the period 1938-1977.

5. EVAPOTRANSPIRATION

Water is lost to the system through evapotranspiration from soils and vegetation and evaporation from open water surfaces. The actual evaporation transpiration (ET) rate can be determined by several different methods. A simple and commonly used method employs the concept of water balance. Accurate measurements are made of precipitation, runoff and groundwater recharge. The water which cannot be accounted for in either the runoff or recharge is the ET rate. The Southwest Florida Water Management District (SWFWMD) cites this rate at 39 inches per year (Water Crop, 1977) based on a study by Cherry, Stewart and Mann (1970). A more recent study by Dohrenwend (1977) states a potential evaporation rate of 45.23 inches for Tampa and an actual rate of 34.84 inches. The potential evaporation rate is the rate which would occur if sufficient moisture were available at all times.

Using the ET rate of 39 inches/year the ET/Precipitation ratio for Lakeland is 0.78 and for Tampa is is 0.80. Using the more recently developed rate of 34.84 inches these ratios are 0.70 and 0.72 for

TABLE 4-E

AVERAGE MONTHLY PRECIPITATION (INCHES) FOR THE TAMPA WEATHER STATION FOR THE PERIOD 1890-1977

Month	Average Precipitation	Minimum[1] Precipitation (year)	Maximum[1] Precipitation (year)
January	2.22	Trace (1950)	5.41 (1958)
February	2.75	0.21 (1950)	7.95 (1963)
March	2.94	0.20 (1945)	12.64 (1959)
April	2.09	Trace (1967)	6.59 (1957)
May	2.92	0.16 (1941)	8.13 (1976)
June	7.05	1.86 (1951)	18.52 (1945)
July	7.87	2.34 (1962)	20.59 (1960)
August	7.98	0.78 (1938)	18.59 (1949)
September	6.50	1.28 (1973)	13.04 (1947)
October	2.70	0.03 (1942)	6.94 (1938)
November	1.63	Trace (1960)	5.38 (1959)
December	2.06	0.09 (1946)	7.04 (1941)
Annual	48.71	28.89 (1956)	70.43 (1957)

[1] Minimum and Maximum precipitations are based on the Tampa record from 1938 to 1977.

Lakeland and Tampa respectively. These calculations are based on the mean annual precipitation reported by NOAA (Local Climatological Summaries).

In order to obtain evaporation rates the U.S. Weather Bureau uses a U.S. Weather Bureau Class A Land Pan which is four feet in diameter and 10 inches deep. The water surface is maintained 2 to 3 inches below the rim of the pan. Inasmuch as the rate of evaporation from small areas is greater than that from large areas, a pan coefficient of 0.70 has been recommended for converting observed open pan evaporation values to an estimated value for lakes or reservoirs (Chow, 1964), and the U.S. Weather Bureau uses a coefficient of 0.77.

The nearest measurement station in southwest Florida is Lake Alfred, an agricultural experiment station located approximately 10 miles east of Lakeland. Recent open pan evaporation rates for this station are summarized in Table 5-A. The measurements are slightly higher than the 60 to 65 inches reported for the area by the U.S. Weather Bureau (1959). The same U.S. Weather Bureau report lists an annual average lake evaporation rate of 50 to 52 inches per year with 60 to 62 percent occurring from May through October.

6. DISPERSION PHENOMENA

Dispersion phenomena are those factors which influence the dispersion of pollutants in the air. These factors include wind speed, direction, seasonal distribution, atmospheric stability, mixing heights and ventilation factors. Factors determining dispersion exhibit noticeable seasonal variation and are treated annually and by season to describe baseline conditions at the proposed mine site.

TABLE 5-A

OPEN PAN EVAPORATION RATES FOR LAKE ALFRED (1971-1977)

Year	Total Open Pan Evaporation (inches)
1977	Incomplete Yearly Record
1976	Incomplete Yearly Record
1975	69.07
1974	70.08
1973	69.04
1972	69.30
1971	68.72

6.1 Wind Direction and Speed

Wind direction and speed measurements accurately describing the site would have required a measurement program of several years duration. In the absence of such a program, the nearest National Weather Service measurement sites were evaluated for usefulness in air quality dispersion modeling.

Long-term wind analysis for Lakeland is limited to 1942-1945. Measurements made subsequent to this period have been presented only on an annual basis. The data for 1942-1945 were presented as monthly and annual means (NOAA, undated). A seasonal summary of these data is presented in Table 6.1-A.

The wind characteristics for Tampa are periodically summarized through NOAA's STAR program. The most recent STAR summary (1969-1973) contained an annual wind analysis; the seasonal characteristics were not addressed. The STAR data for the period 1965-1969 presented both seasonal and annual summaries. Since the seasonal characteristics are important the 1965-1969 data were used for this report. The seasonal frequency distribution and mean wind speed for Tampa are presented in Table 6.1-B.

Wind roses showing relative distribution frequencies for Lakeland and Tampa are given in Figures 6.1-1 and 6.1-2. These figures clearly indicate a significant difference in the wind distribution patterns for the two areas. The Lakeland data demonstrates a major influence from the Tradewinds and the passage of frontal system through the area. During the spring and summer months the winds are from the east and south. During the fall and winter there is a shift to a much more northerly direction (NOAA, undated).

TABLE 6.1-A

SEASONAL WIND DISTRIBUTION FREQUENCY AND WIND SPEED FOR LAKELAND (1942-1945)

Direction	SPRING				SUMMER				FALL				WINTER				ANNUAL			
	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec
N	4.1	5.9	6.8	3.48	3.2	4.6	5.3	2.71	10.2	4.8	5.5	2.82	8.6	5.6	6.5	3.34	6.9	7.1	8.2	4.21
NNE	5.6	6.8	7.8	4.02	2.3	5.2	6.0	3.10	8.5	5.8	6.7	3.44	7.0	6.7	7.7	3.96	6.1	8.3	9.6	4.92
NE	8.4	7.4	8.5	4.40	7.3	4.6	5.3	2.71	18.4	6.5	7.5	3.87	8.5	6.1	7.0	3.58	11.0	8.3	9.6	4.92
ENE	9.6	8.3	9.6	4.96	6.0	5.4	6.2	3.18	9.3	6.5	7.5	3.84	6.8	6.4	7.4	3.81	8.0	9.0	10.4	5.33
E	9.9	6.9	8.0	4.13	6.6	4.5	5.2	2.69	8.6	6.3	7.3	3.74	6.0	5.8	6.7	3.44	7.7	7.3	8.4	4.33
ESE	8.0	7.4	8.5	4.35	6.1	5.2	6.0	3.08	3.1	5.0	5.8	3.00	3.1	6.4	7.4	3.78	4.8	8.1	9.3	4.80
SE	8.9	6.9	8.0	4.10	10.7	4.3	4.9	2.53	4.2	4.4	5.1	2.60	4.4	5.2	6.0	3.08	6.7	7.0	8.1	4.15
SSE	6.3	7.6	8.8	4.54	5.7	4.8	5.5	2.85	1.7	4.4	5.1	2.65	4.3	7.0	8.1	4.14	4.3	8.6	9.9	5.10
S	5.1	7.1	8.2	4.24	6.3	4.5	5.2	2.70	2.8	4.3	4.9	2.53	5.5	6.8	7.8	3.99	4.8	7.9	9.1	4.68
SSW	4.5	8.2	9.5	4.88	6.4	4.9	5.7	2.92	1.8	4.5	5.2	2.70	4.4	8.0	9.2	4.72	4.1	9.0	10.4	5.33
SW	5.5	8.1	9.3	4.80	7.4	5.3	6.1	3.13	2.9	4.6	5.3	2.74	5.3	7.2	8.3	4.26	5.1	8.7	10.0	5.16
WSW	3.2	8.3	9.6	4.95	2.8	5.6	6.4	3.28	1.7	5.3	6.1	3.16	2.9	6.9	8.0	4.10	2.6	9.2	10.6	5.45
W	4.0	7.1	8.2	4.21	4.1	6.1	7.0	3.60	2.7	5.4	6.2	3.20	4.6	6.7	7.7	3.95	3.8	8.5	9.8	5.04
WNW	3.5	7.4	8.5	4.35	3.3	6.3	7.3	3.77	3.1	6.7	7.7	3.96	6.9	7.7	8.9	4.60	4.3	9.6	11.1	5.69
NW	3.9	7.4	8.5	4.36	4.2	5.5	6.3	3.26	6.3	5.4	6.2	3.19	8.2	6.4	7.4	3.80	5.9	8.3	9.6	4.92
NNW	3.0	5.6	6.4	3.29	2.1	5.0	5.8	2.96	5.2	4.5	5.2	2.67	5.9	5.6	6.4	3.29	4.3	7.0	8.1	4.15
CALM	6.4				15.4				9.6				7.7				9.6			
Mean Wind Speed		7.3	8.4	4.32		5.1	5.9	3.04		4.9	5.6	2.88		6.6	7.6	3.91		7.4	8.5	4.39

TABLE 6.1-B

SEASONAL WIND DISTRIBUTION FREQUENCY AND WIND SPEED FOR TAMPA (1965-1969)

Direction	SPRING				SUMMER				FALL				WINTER				ANNUAL			
	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec	Distribution Frequency %	Mean Wind Speed MPH	Knots	M/Sec
N	4.1	5.8	6.7	3.44	3.2	6.3	7.2	3.71	10.2	6.4	7.4	3.81	8.6	6.5	7.5	3.86	6.5	6.3	7.3	3.75
NNE	5.6	6.0	6.9	3.55	2.3	5.1	5.9	3.04	8.5	6.9	7.9	4.07	7.0	6.9	7.9	4.07	6.3	6.5	7.5	3.86
NE	8.4	6.6	7.6	3.91	7.3	5.4	6.2	3.19	18.4	6.9	7.9	4.07	8.5	6.9	7.9	4.07	8.0	6.5	7.5	3.86
ENE	9.6	6.3	7.3	3.75	6.0	5.3	6.1	3.14	9.3	6.5	7.5	3.86	6.8	6.2	7.1	3.71	10.8	6.2	7.1	3.71
E	9.9	7.3	8.4	4.32	6.6	5.4	6.2	3.19	8.6	6.6	7.6	3.91	6.0	6.3	7.2	3.71	14.8	6.3	7.3	3.75
ESE	8.0	7.2	8.3	4.27	6.1	5.6	6.5	3.35	3.1	6.3	7.2	3.71	3.1	6.5	7.5	3.86	6.8	6.3	7.3	3.75
SE	8.9	7.1	8.2	4.22	10.7	5.5	6.3	3.24	4.2	6.6	7.6	3.91	4.4	6.9	7.9	4.07	4.9	6.4	7.4	3.81
SSE	6.3	6.9	8.0	4.12	5.7	5.5	6.3	3.24	1.7	5.6	6.4	3.29	4.3	6.9	7.9	4.07	5.1	6.2	7.1	3.71
S	5.1	8.7	10.0	5.15	6.3	6.3	7.2	3.71	2.8	6.4	7.4	3.81	5.5	7.8	9.0	4.63	5.1	7.4	8.5	4.37
SSW	4.5	8.2	9.4	4.83	6.4	6.8	7.8	4.01	1.8	6.4	7.4	3.81	4.4	7.0	8.1	4.17	3.2	7.3	8.4	4.32
SW	5.5	7.4	8.5	4.37	7.4	6.3	7.3	3.75	2.9	5.9	6.8	3.50	5.3	6.4	7.4	3.81	2.6	6.6	7.6	3.91
WSW	3.2	7.5	8.6	4.43	2.8	6.4	7.4	3.81	1.7	6.2	7.1	3.71	2.9	5.9	6.8	3.50	4.0	6.3	7.6	3.91
W	4.0	8.7	10.0	5.15	4.1	7.0	8.1	4.17	2.7	6.7	7.7	3.96	4.6	6.9	7.9	4.07	8.5	7.6	8.7	4.48
WNW	3.5	7.6	8.8	4.53	3.3	6.3	7.3	3.75	3.1	7.1	8.2	4.22	6.9	8.0	9.2	4.74	3.8	7.4	8.5	4.37
NW	3.9	7.0	8.1	4.17	4.2	6.1	7.0	3.60	6.3	6.7	7.7	3.96	8.2	8.1	9.3	4.79	4.7	7.1	8.2	4.22
NNW	3.0	6.7	7.7	3.96	2.1	5.8	6.7	3.40	5.2	6.5	7.5	3.86	5.9	8.6	9.9	5.10	4.8	7.3	8.4	4.32
CALM	6.4				15.4				9.6				7.7				4.6			
Mean Wind Speed		6.9	8.0	4.12		5.6	6.5	3.35		6.3	7.2	3.71		6.6	7.6	3.91		6.3	7.3	3.75

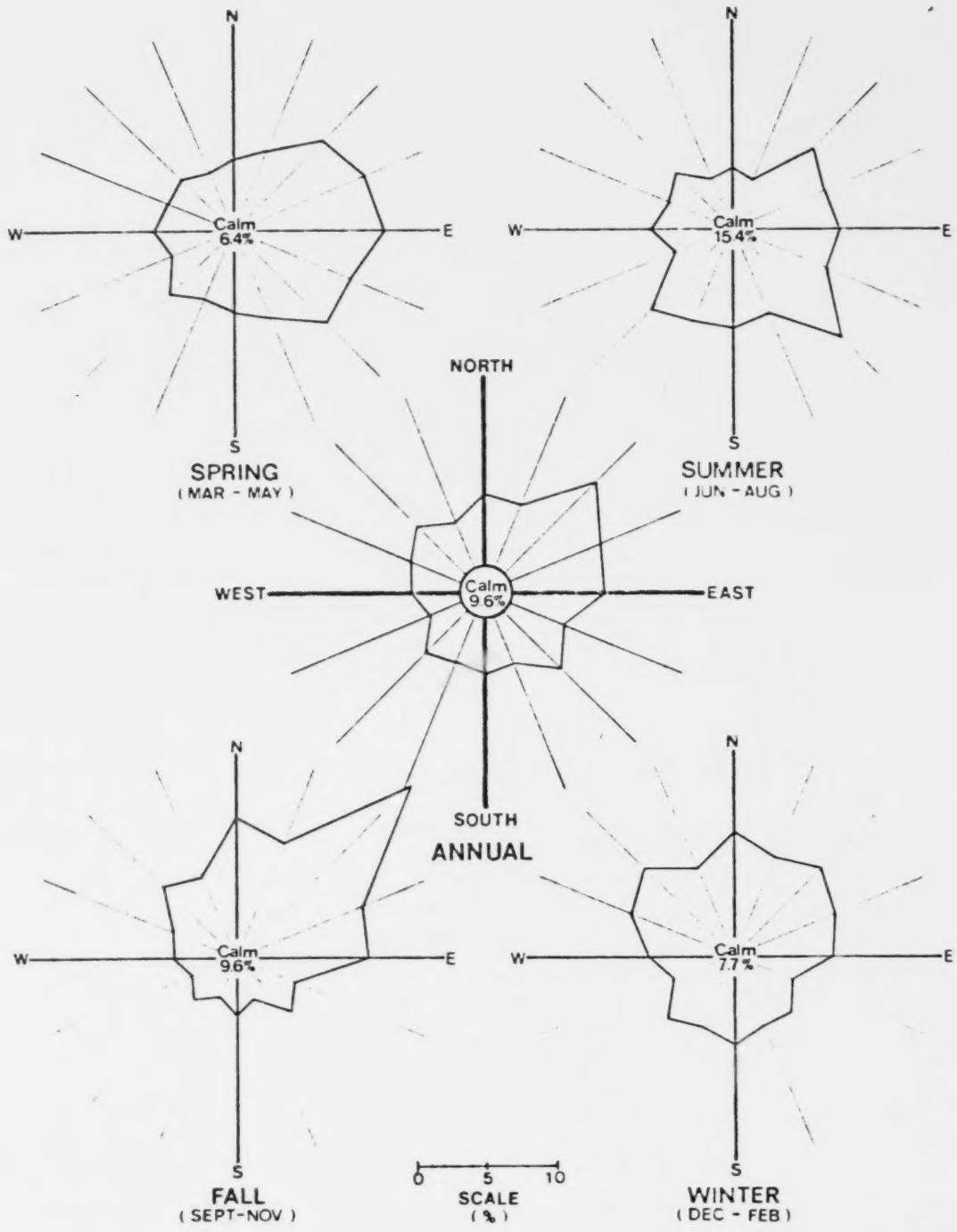


FIGURE 6.1-1 SEASONAL WIND ROSES FOR LAKELAND, 1942-1945

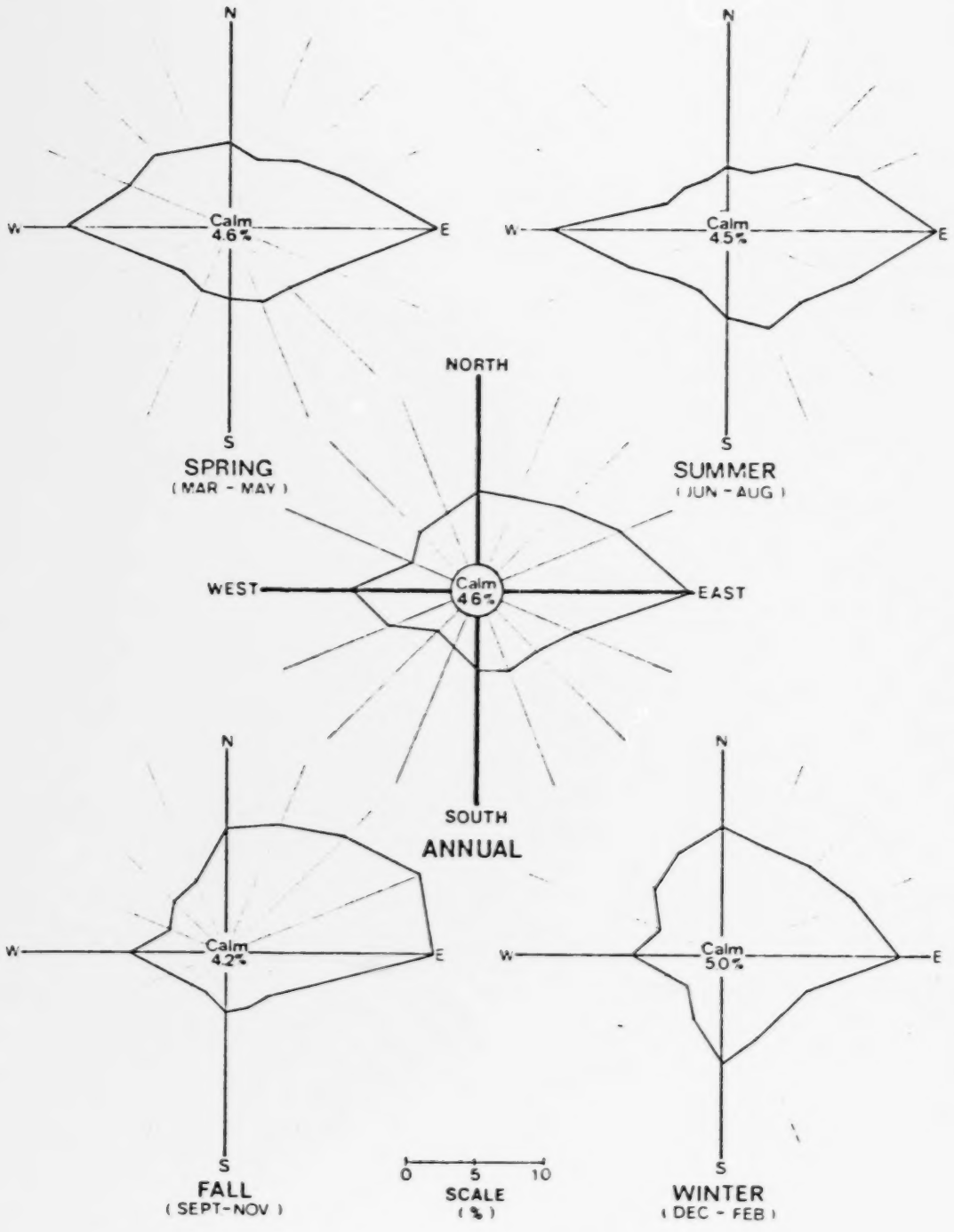


FIGURE 6.1-2 SEASONAL WIND ROSES FOR TAMPA, 1964-1969

The major influence on the Tampa wind distribution is the land-sea interaction. The winds are predominantly easterly throughout the year. The winds are more westerly during spring and summer than during the winter and fall when there is stronger northerly component (NOAA, 1972).

The mean annual wind speed for Lakeland (1942-1945) was 8.5 knots (4.39 meters per second, 7.4 miles per hour). The highest seasonal mean wind speed was 8.4 knots (4.32 meters per second, 7.3 miles per hour) in the spring and the lowest was 5.6 knots (2.88 meters per second, 4.9 miles per hour) in the fall. A wind speed of 13.8 knots (7.11 meters per second, 12 miles per hour) was exceeded 13.6 percent of the time.

The mean annual wind speed for Tampa is 7.3 knots (3.75 meters per second, 6.3 miles per hour). The highest mean seasonal wind speed of 8.0 knots (4.12 meters per second, 7 miles per hour) was for the spring. The lowest wind speed of 6.5 knots (3.35 meters per second, 5.7 miles per hour) was in the summer. A wind speed of 10 knots (5.15 meters per second, 8.7 miles per hour) was exceeded 17.63 percent of the time. Table 6.1-C, presents select wind speed and the percent of time these wind speeds were exceeded for Tampa.

6.2 Wind Distribution by Stability Class

Pasquill stability classes are a useful tool for describing the atmosphere's capability to disperse air pollutants and are relied upon for atmospheric modeling. The stability classes are determined from the intensity of incoming solar radiation, percent cloud cover, cloud

TABLE 6.1-C

SELECT WIND SPEED EXCEEDENCE FREQUENCY (% OF TOTAL TIME) FOR TAMPA 1965-1969

Wind Speed		Frequency Exceeded (%)
Knots	m/Second	
3	1.51	89.31
6	3.08	54.54
10	5.15	17.63
16	8.24	1.46
21	10.81	0.33

ceiling, and surface wind speed. The stability classes are described as follows:

Class	Definition
A	Extremely unstable (extreme afternoon turbulence)
B	Unstable
C	Slightly unstable
D	Neutral (turbulence virtually absent — conditionally unstable)
E	Slightly stable
F	Stable to extremely stable (atmospheric stratification)

Table 6.2-A, summarizes NOAA data annually and seasonally by stability class for Tampa from 1965-1969. Classes E and F are combined as present pollution dispersion modeling techniques do not provide treatment for these classes.

6.3 Mixing Depth and Ventilation Factors

The mixing depth is the depth above the surface through which relatively vigorous vertical mixing occurs. The mixing depth is based upon the dry adiabatic lapse rate. The ventilation factor is the mixing depth times the average wind speed through the mixing depth. Cubic meters of air available for dilution can be determined from this factor by multiplying it by the distance transversed. Table 6.3-A, lists mean seasonal mixing depths, mean wind speed through the mixing depth and ventilation factors for Tampa (NOAA, 1968). These were calculated from non-precipitation events as the assumption of a dry adiabatic lapse rate in the mixing layer becomes questionable when precipitation occurs (Holzworth, 1972). A mixing depth of 150 meters or less occurred

TABLE 6.2-A

SEASONAL RELATIVE FREQUENCY WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES FOR TAMPA, 1965-1969

Stability Class	Season				
	Spring	Summer	Fall	Winter	Annual
A	0.24	0.73	0.19	0.03	0.31
B	6.74	13.13	5.72	2.47	7.04
C	15.25	17.85	13.50	12.36	14.76
D	40.39	28.64	35.50	45.29	37.42
E, F	37.35	39.65	45.09	39.85	40.47
TOTAL	100.00	100.00	100.00	100.00	100.00

TABLE 6.3-A

MEAN ANNUAL AND SEASONAL MAXIMUM AND MINIMUM MIXING DEPTHS (M) FOR NON-PRECIPITATION EVENTS, WITH MEAN WIND SPEEDS (M/SEC) THROUGH THE MIXING DEPTH AND VENTILATION FACTORS (m^2/Sec) FOR TAMPA FOR THE PERIOD 1960-1964. (NOAA, 1968; Summarized Holzworth, 1972)

Time Period	Mean Maximum Mixing Depth (M)	Mean Wind Speed (m/Sec)	Ventilation Factor (m^2/Sec)	Mean Minimum Mixing Depth (M)	Mean Wind Speed (m/Sec)	Ventilation Factor (m^2/Sec)
Annual	1359	6.2	8426	493	5.3	2613
Spring	1523	6.7	10204	503	5.6	2817
Summer	1460	5.0	7300	656	4.2	2755
Fall	1401	6.6	9247	419	5.4	2263
Winter	1052	6.4	6733	394	5.8	2285

15.7 percent of the time from 1960 through 1965. The greatest occurrence of these low mixing height conditions can be expected from October through May. A mixing height of less than 120 meters can be expected about 10 percent of the time (NOAA, 1968). The average morning mixing depth is 493 meter for non-precipitation cases with an average wind speed of 5.3 meters/second. The average afternoon mixing depth is 1359 meters for non-precipitation cases with an average wind speed of 7.8 meters/second (Holzworth, 1972).

6.4 Episode Occurrence Frequency

The U. S. Environmental Protection Agency defines episode (stagnation) conditions to exist when the mixing depth is less than 1500 meters with an average wind speed through the mixing depth of less than 4 meters/second. Table 6.4-A, summarizes the occurrence of episode conditions for Tampa from 1960 through 1964. There were approximately two times per year when episodes exceed two days and those of three day duration occurred about once every two years (NOAA, 1968).

7. SEVERE WEATHER

Macroclimatic hazards include storms of hurricane intensity (winds of 74 mph or greater), tornados, hailstorms, and severe thundershowers.

7.1 Tropical Cyclones

A hurricane is a tropical cyclone with winds of 74 mph or higher. These cyclones usually occur in tropical waters during the summer and fall. The Keys hurricane of September 2, 1935, was the most violent ever recorded. It has been estimated that this hurricane had sustained

TABLE 6.4-A

FREQUENCY OF EPISODES FOR TAMPA, FLORIDA FROM 1960 THROUGH 1964 (NOAA, 1968)

Month	Length of Stagnation Period			
	12 Hrs.	24 Hrs.	48 Hrs.	72 Hrs.
January	2.8	1.4	0.2	0.0
February	2.4	1.4	0.4	0.2
March	1.0	0.4	0.2	0.0
April	0.8	0.4	0.0	0.0
May	0.8	0.4	0.0	0.0
June	2.8	2.2	0.0	0.0
July	3.6	1.2	0.4	0.2
August	3.6	2.8	0.2	0.0
September	1.8	0.8	0.0	0.0
October	1.8	1.0	0.0	0.0
November	2.2	1.0	0.0	0.0
December	2.8	1.4	0.4	0.2
Annual Total	26.4	14.4	1.8	0.6

winds in excess of 200 mph (Dunn, 1967). The probability of a hurricane striking Tampa is 1 in 20 (there is less probability of inland areas being exposed to hurricane force winds), however, no area in Florida is immune to these storms. The intense rains associated with hurricanes usually cover a much broader area than the winds and would undoubtedly effect the proposed mine site if a hurricane were to strike the Tampa Bay region. Precipitation associated with hurricanes is normally from 5 to 10 inches depending on speed of the hurricane. An example of these heavy precipitation events is noted for Fort Meade, an inland area near the proposed mine site, where 14.5 inches of rain was recorded in September, 1903, in association with a hurricane (Dunn, 1967).

7.2 Tornados

Tornados can occur anywhere in Florida. Lakeland and the proposed mine site lie within a 1° square which had a total of 43 tornados between 1955 and 1967. During this same period the greatest number (92) of tornados occurred in the month of June (Pautz, 1969).

7.3 Hailstorms

The west central region of Florida does not frequently experience hailstorms, however, they do occur. The proposed mine site lies within a 1° square which had a total of 9 hailstorms with 3/4 inch hail or greater for the period 1955-1967 (Pautz, 1969).

7.4 Wind Storms

The proposed mine site lies within a 1° square which had 19 wind storms of 50 knots or greater during the period 1955 through 1957 (Pautz, 1969).

7.5 Thundershowers

Tampa has about 90 days per year with thundershower activity and Lakeland has about 100. These showers occur mostly during the rainy season. The showers are often short, lasting only an hour or two during the late afternoon and evening hours. The more severe thundershowers are sometimes attended by hail or locally strong winds which may inflict serious damage to crops and property (Bradley, 1972).

BIBLIOGRAPHY

Bradley, James T., 1972. Climates of the States, Climate of Florida, Climatography of the United States No. 60-8. N.O.A.A. Environmental Data Service. 30 pp.

Cherry, R. N., J. W. Stewart, J. A. Mann, 1970. General Hydrology of the Middle Gulf Area, Florida, U.S. Geologic Survey, Report of Investigation No. 56. 96 pp.

Chow, Ven Te, ed. 1964. Handbook of Applied Hydrology, a Compendium of Water Resources Technology. McGraw Hill Book Company.

Dohrenwend, Robert E., 1977. Evapotranspiration Patterns in Florida. Florida Scientist 40: 184-192.

Dunn, Gordon E. and Staff, 1967. Florida Hurricanes. ESSA Technical Memorandum WBTM-SR-38, Fort Worth, Texas. 26 pp.

Holzworth, George C., 1972. Mixing Heights, Wind Speeds and Potential for Urban Air Pollution Throughout the Contiguous United States. U.S. Environmental Protection Agency, Office of Air Programs Publication No. AP-101. 117 pp.

N.O.A.A. (undated). Surface Winds, Frequency of Occurrence, Direction by Speed Groups, Lakeland, Florida, 1942-1945.

N.O.A.A., 1968. Tabulation I, Frequency of Occurrence Average Wind Speed Through Mixing Depth for "NOP" Cases. Job No. 06234. Environmental Data Service.

N.O.A.A., 1968. Tabulation II, Frequency of Episodes. Job No. 06234. Environmental Data Service.

N.O.A.A., 1968. Tabulation III, Daily Mixing Heights and Average Wind Speed. Job No. 06234. Environmental Data Service.

N.O.A.A., 1972. Seasonal and Annual Wind Distribution by Pasquill Stability Classes (5). 1965-1969. STAR Program. Job No. 12926. Environmental Data Service.

N.O.A.A., 1962-1977. Climatological Data, Florida Annual Summaries. Environmental Data Service.

N.O.A.A., 1977a. Local Climatological Data; Annual Summary with Comparative Data, Lakeland, Florida.

N.O.A.A., 1977b. Local Climatological Data; Annual Summary with Comparative Data, Tampa, Florida.

BIBLIOGRAPHY
(Continued)

Pautz, Maurice E., ed., 1969. Severe Local Storm Occurrences, 1955-1967. ESSA Technical Memorandum, WBTM-FCST-12, Silver Spring, Maryland. 77 pp.

Peek, Harry M., 1958. Groundwater Resources of Manatee County, Florida. Florida Geological Survey, Report of Investigations No. 18.

Southwest Florida Water Management District, 1977. The Water Crop. Information Series 7080. 13 pp.

U.S. Weather Bureau, 1959. Evaporation Maps for the United States. Technical Paper No. 37. 13 pp. 5 plates.